

REMARKS

Claims 1-14 are all the claims pending in the application. Claims 1-5 and 8-10 are rejected. Claims 8-10 also are objected to. Claims 6, 7 and 11-14 are withdrawn from consideration. Claims 1, 2, 4, 9 and 10 are amended. New claim 15 is added.

Election/Restriction

The Examiner acknowledges Applicant's traversal of the Election/Restriction requirement as presented in the reply on May 27, 2005. The Examiner does not find the Applicants' arguments persuasive and renders the requirement final. Applicants respectfully maintain their position that the examination of the withdrawn claims does not present a burden and would only enhance the efficiency of the examination process.

Drawings

The Examiner objects to the drawings because the polishing liquid supply portion 9, as described in the specification at page 20, lines 13-14, is not shown in the Figure. The structure for supplying a liquid is well known in the art. Rather than amend the drawings, Applicants propose simply deleting the reference numeral 9 from the specification.

Similarly, with respect to the Examiner's objection that the reference numerals 3 and 4 are both used to designate the internal gear, Applicants respectfully submit that the proper designation is by numeral 3, as reference numeral 4 is the carrier, as is clear from the figure. Again, Applicants have made appropriate changes at page 20.

Specification

The Examiner objects to the reference to the Japanese priority document at page 1 of the specification and the statement that the disclosure is incorporated by reference. Applicant disagrees with this objection. First, machine translations of the Japanese priority document are available on the JPO website. Second, the incorporation is used to ensure that, if there are errors or omissions in the translation of any pertinent part of the US specification, there will be support for any needed change. Such practice has been acknowledged as proper by the courts and the USPTO, as noted in MPEP 2163.07.

The Examiner has identified certain phrases that appear in the original English language translation of the specification and finds them to be indefinite, failing to meet the requirement for “full, clear, concise and exact terms.” The Examiner gives two examples and has interpreted these phrases correctly. Applicants submit that the phrases would be clear to one skilled in the art, and would be interpreted properly, as the Examiner has done. Nonetheless, appropriate changes have been made in accordance with the Examiner’s suggestions. No new matter is added and support is taken from the text as would be understood by one skilled in the art.

Finally, with respect to the Examiner’s comment about the differences in pressure and time, these are times derived by the Applicants for a variety of conditions and on the basis of the goal of suppressing a protrusion or defect on a convex surface, as subsequently explained. The times do not need to vary linearly or proportionately to the pressure

As for any other indefiniteness, Applicants stand ready to make changes where the Examiner identifies grammatical or spelling errors or instances of indefiniteness. However, Applicants have endeavored to identify any language that the Examiner might find objectionable and could not find any more. Should further errors be identified, the need for changes will be considered and the errors corrected as necessary.

Claim Objections

The Examiner has objected to claims 8-10 as being dependent on a non-elected claim. In order to advance prosecution, the Examiner has interpreted claims 8 and 9 as depending from elected claims 1, 2 or 4. Applicants greatly appreciate the Examiner’s cooperation in this regard and have made appropriate changes to the claims in the present amendment.

Claim Rejections - 35 U.S.C. § 112

Claims 2-3 and 8-10 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. This rejection is traversed for at least the following reasons.

The Examiner has questioned the meaning of the term “neutral polishing liquid,” but has interpreted the phrase as referring to a liquid with a pH of 6-8, preferably 7.0-7.6, as supported

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by the disclosure of the second embodiment at pages 8-9. An appropriate clarifying amendment has been made to the claims.

Claim Rejections - 35 U.S.C. § 102

Claims 1 and 3 are rejected under 35 U.S.C. § 102(b) as being anticipated by Shibano et al (JP 01040267). This rejection is traversed for at least the following reasons.

Claim 1 has been amended in order to state that the polishing liquid has a pH value between 7.0 and 7.6. There is no teaching or suggestion of such range in Shibano et al. Thus, the claim cannot be anticipated.

Claims 1-2 and 8 are rejected under 35 U.S.C. § 102(b) as being anticipated by Berkey et al (6,265,115). This rejection is traversed for at least the following reasons.

Claim 1 has been amended in order to state that the polishing liquid has a pH value between 7.0 and 7.6. There is no teaching or suggestion of such range in Berkey et al. Thus, the claim cannot be anticipated.

Claims 4 and 5 are rejected under 35 U.S.C. § 102(b) as being anticipated by Watanabe et al (6,277,465). This rejection is traversed for at least the following reasons.

Claim 4 has been amended in order to state that the polishing step is preformed to suppress occurrence of a fine convex protrusion generated immediately before an end of the polishing process. There is no teaching or suggestion of such feature in Watanabe et al. Thus, the claim cannot be anticipated.

Claim Rejections - 35 U.S.C. § 103

Claims 1-2 and 8 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Berkey et al (6,265,115). This rejection is traversed for at least the following reasons.

Claim 3 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Shibano et al in view of Berkey et al (6,265,115). This rejection is traversed for at least the following reasons.

The Invention

The object of the present invention is to suppress occurrence of a fine convex surface defect that is generated upon polishing the glass substrate and to provide a method of manufacturing a mask blank for the next-generation lithography, free from a pattern defect that would be caused by the surface defect. In particular, the fine convex surface defect causes a very serious problem as the exposure wavelength of the exposure light becomes shorter.

In accomplishing the object of the invention, the present invention has the following significant features:

(1) The polishing liquid containing a colloidal silica as abrasive grains, which is used in the final polishing step (the ultrahigh precision polishing step), has a pH value range such that the occurrence of the convex surface defect can be suppressed.

(2) The pressure applied to the glass substrate immediately before the end of the polishing process is controlled to a value lower than the predetermined pressure in order to minimize the polishing rate.

(3) In the cleaning step after the end of the polishing process, use is made of a cleaning liquid in which (a) the etching action of an impurity (such as a metal particle contained in the polishing liquid) adhered to the surface of the substrate is stronger than (b) the etching action of the glass substrate.

As to the above-mentioned feature (1), specifically, a pH value range for the polishing liquid is selected to be in the neutral region between 7.0 and 7.6. As a consequence, the occurrence of a convex surface defect can be suppressed, as compared with the conventional case in which the polishing liquid is used in the alkali region, by increasing pH value in view of the stability of the colloidal silica of the abrasive grains and the etching effect of the glass substrate.

As to the above-mentioned feature (2), the polishing rate can be minimized. Thus, the height of the protrusion, which is formed by the difference in polishing rate between the portion

where the adhered substance is adhered to the glass substrate and the remaining portion, can be suppressed.

As to the above mentioned feature (3), the etching operation of the cleaning liquid is utilized so that the height of the protrusion can be reduced.

On the basis of the foregoing summary, there is a clear difference between the present invention and Shibano et al and Berkey et al.

First, Berkey fails to disclose any method of manufacturing the colloidal silica, and therefore, the manufacturing method thereof is not expressly or implicitly taught.

Second, in both Shibano and Berkey, the polishing liquid is used in the high alkali region (for example, pH=9-11(see page 1937 in Shibano), pH=8-12 (See col. 13, lines 46-47 in Berkey)). This alkali level is needed in order to provide the polishing liquid with for an etching effect on the glass substrate, regardless of the method of producing the colloidal silica. By contrast, according to the present invention, the polishing liquid is used in the neutral region (namely, the pH value between 7.0 and 7.6). In this respect, the present invention is different from both Shibano and Berkey. As previously explained, in the present invention, the polishing liquid is used in the neutral region in order to prevent the occurrence of a fine convex surface defect generated in the polishing process. According to the study of the present inventors, the dehydration/condensation reaction is caused at the surface layer portion of the polishing particles through the hydroxyl group on the surface of the polisher in the high alkali region. It is presumed that, via repetition of the above-mentioned reaction, the aggregate that causes the protrusion defect is formed.

Third, both Shibano and Berkey fail to teach the problem with respect to the fine convex surface defect generated in the polishing process. In this respect, the present invention is different in object from both Shibano and Berkey.

Fourth, the present invention has been derived from the study by the present inventors of the generation mechanism of the convex surface defect. Neither of the cited references teaches

this mechanism. Therefore, the present invention is not anticipated or obvious from the cited references.

In order to clarify the above-mentioned feature of the present, claims 1 and 2 are amended to state expressly that the polishing liquid has the PH value between 7.0 and 7.6, as mentioned above. This feature is not disclosed in both Shibano and Berkey.

Claims 4-5 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Watanabe et al (6,277,465). This rejection is traversed for at least the following reasons.

Claims 4-5 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Shibano et al in view of Watanabe et al (6,277,465). This rejection is traversed for at least the following reasons.

In Watanabe, the polishing liquid used in the final polishing step (the third polishing step) contains the colloidal silica. Further, the load applied to the substrate is lower than the load in the polishing step (the second polishing step) immediately before the final polishing step so that the polishing is carried out under the load of 100 g/cm² or less.

However, in both Watanabe and Shibano, a plurality of polishing steps is carried out for the following reason. Specifically, the polishing liquid (the abrasive grains) are gradually changed in each polishing step so that the abrasive grain is reduced in diameter and the load is adjusted. Thus, by changing the surface of the substrate from the rough state to the fine state, the desired surface roughness can be effectively obtained.

By contrast, in the present invention, a plurality of polishing steps are carried out in order to suppress the height of the protrusion of the convex surface defect occurred in the polishing process. In this respect, the present invention is different from Watanabe.

Moreover, in Watanabe, the final polishing step (the third polishing step) and the polishing step (the second polishing step) immediately before the final polishing step are different with respect to each other, not only in load but also polishing liquid (abrasive grains). Therefore, these are separate steps and not a common step.

By contrast, in the present invention, in the same step (the ultrahigh precision polishing step), immediately before stopping of the rotation of the polishing surface table ,i.e., after an elapse of the polishing time for obtaining the desired surface roughness, the applied pressure is lowered to 100 g/cm² or less. Thus, the surface roughness control step and the protrusion suppressing step constitute a series of sequences in the same polishing process. In this respect, the present invention is different from Watanabe.

Further, in the protrusion suppressing step of the present invention, the processing time of the constant time or more is necessary for a low level load in order to suppress the height of the protrusion. The processing time, thus, falls within the range between 90 and 360 seconds.

By contrast, in Watanabe, the polishing time falls within the range between 5 and 20 minutes (See col. 5, line 11 in Watanabe). In this respect, the present invention is different from Watanabe.

Specifically, in the process of suppressing a protrusion, colloidal silica forms an aggregate and is retained on the surface of the substrate. However, polishing is inhibited only at the portion where the aggregate is retained by the remaining substance. As a result, a residue is formed (e.g., the fine convex surface defect occurs). Further, according to the inventors experiment, it appears that the residue occurs when the aggregate is retained at one position for about 2-5 seconds. Consequently, the protrusion step quantity (difference in level) is lowered by reducing the processing pressure and the polishing rate. Thus, according to the present invention, it is possible to prevent occurrence of a fine convex protrusion that exceeds a range corresponding to a phase defect that is allowable in the glass substrate for the mask blank.

In order to clarify the above-mentioned feature of the present, claim 4 has been amended. Moreover, new Claim 15 has been added in order to specify a specific polishing rate.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

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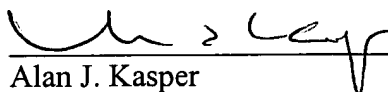
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